AC 2011-1309: AERIM AUTOMOTIVE-THEMED REU PROGRAM : ORGANIZATION, ACTIVITIES, OUTCOMES AND LESSONS LEARNED

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AERIM Automotive-themed REU Program: Organization, Activities, Outcomes and Lessons Learned

Abstract

The department of Mechanical Engineering at Oakland University received funding in 2006-2008 and again in 2010-2012 through the National Science Foundation Research Experience for Undergraduates (REU) and the Department of Defense Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE) programs to organize a summer research experience for undergraduates program that focuses on automotive and energy-related research. The Automotive and Energy Research and Industrial Mentorship (AERIM) REU program at Oakland University aims to engage participants in rewarding automotive research experiences that excite and motivate them to pursue careers in scientific and engineering research, and seeks to address the nationwide problem of the under-representation of women and minorities in science, technology, engineering and math (STEM). Student participants work in teams on automotive and energy-related research projects in mechanical engineering and also take part in other activities such as industrial research lab and facilities tours, meetings with working engineers, conferences and seminars. To date, a total of 37 students– more than half of whom were female - from 30 different universities have taken part in the program since its inception in 2006.

The purpose of this paper is to present some of the lessons learned from the first four years of the program. Some of the planning, logistics, procedures and outcomes will be described and analyzed based on the results from the pre- and post-surveys conducted to assess the program. We believe that this type of information would prove useful to others seeking to organize similar programs.

Introduction

The U.S. has long been the worldwide leader in science and technology and continues to be so. However, addressing some of the biggest challenges facing the world today, such as climate change and energy supplies, requires that the U.S. increase its pool of talented, globally competitive and highly educated engineers and scientists. Developing such a workforce requires not only attracting more students into STEM fields, but also tapping into the reservoir of female and minority students who continue to shy away from engineering fields and mechanical engineering in particular and retaining them in these fields. Numerous studies have shown that active participation in real-life research is one of the most effective ways to attract and retain talented undergraduates and motivate them towards pursuing careers in engineering and science.[1-4] Data indicates that undergraduate students in general, and women and minority students in particular, report increased skills, confidence and motivation to pursue science or engineering careers as a result of research experiences, positive relations with mentors, supportive campus climate and opportunities to have the students' work recognized through conference presentations or awards.[5] Undergraduate research is one way for students to feel more connected to their educational experience, to see the value of scientific inquiry in the "real world," to feel a greater sense of empowerment as learners, and just as importantly, to generate enthusiasm about the field.[6, 7] A research experience also gives students an edge in an increasingly competitive

knowledge-based global economy in which the emphasis is as much on what students are capable of learning in the future as it is on how much they know when they graduate. Their ability to adapt quickly to new situations and to solve difficult problems is essential, and research skills greatly enhance that capacity.[8]

One way of providing students with the opportunity to take part in hands-on and active inquiry is through full-immersion summer undergraduate research programs. The highly successful *Research Experience for Undergraduates* (REU) program setup by the National Science Foundation has been key to providing such research opportunities for countless undergraduate students across the U.S. in a wide range of fields that can peak the interests of students of varied backgrounds. [9-15] One such REU site is the Automotive and Energy Research and Industrial Mentorship (AERIM) REU program at Oakland University (OU).[16] First started in 2006, the primary objective of this REU site is to each summer engage between 8 and 10 undergraduate students, particularly women, in rewarding automotive and energy-related research experiences that excite and motivate them to embark upon graduate studies and pursue careers in scientific and engineering research in industry, government or academia. The primary automotive focus of this REU program was a natural choice given OU's close ties to and location near the world headquarters and engineering centers of the Big-Three automakers, as well as over one hundred automotive suppliers in southeast Michigan.

Since its inception in the summer of 2006, a total of 37 undergraduate engineering students from across the United States – 19 of whom were female – have taken part in the program. Each summer the students spend 10 weeks working in teams on their research projects, and also take part in other activities such as industrial research lab and facilities tours, meetings with working engineers, conferences and seminars. The summer research experience is then capped by oral and/or poster presentations by the students of their research projects. Throughout this program, students worked closely with faculty, industrial mentors and graduate students. More than 40 professionals from industry, varying in rank from senior vice presidents to researchers, to program directors, to young engineers, assisted the program at different levels. These industry mentors volunteered to assist the REU students in a number of different ways; Some provided guidance or materials for the research projects; others organized laboratory/industrial tours, gave seminars, found speakers, or simply had informal discussions with the students on a variety of topics including the automotive or energy industry, technology and career choices. [17]

In this paper we discuss some of the experience that we gained from organizing this REU program over the past 4 years. Emphasis will be placed on the lessons learned and on the assessment of the program outcomes.

The Application and Advertising Process

One of the first key steps in organizing an REU program is advertising. After all, without student applications and student participants, the program cannot run. Over the years we have found that a mix of snail-mail, email, word-of-mouth and in-person advertising was effective at advertising and generating interest in the program. Flyers with information about the program and a link to the website were e-mailed and mailed to a number of institutions nationwide. A link to the program website was setup through the NSF REU page and the following people were contacted,

among others: department heads of mechanical engineering programs via a list-serv of Mechanical Engineering dept. chairs; e-mails to faculty advisors of SAE, SWE, SME and NSBE student groups; individual faculty members at various institutions; advising coordinators at neighboring community colleges; past REU participants; past applicants and students who were identified by faculty at Oakland University and elsewhere. The program was open to undergraduate engineering, science or math students entering their sophomore, junior or senior year with a GPA of 3.0 or above. Applications were also accepted from students with slightly lower GPA's in order to allow for applications from students who might not traditionally apply to this type of program and who might greatly benefit from the experience. Over 180 applications were received from more than 80 different institutions across the country in the four years that we have run the program. Each year, about 1/3 to 1/2 of these applications were from female students, which indicated that we were able to reach one of our targeted audiences. Of all the recruiting efforts used, the most effective were the messages sent to faculty advisors of SAE and SWE, as most of the students had heard about the program through e-mails sent or flyers posted by these advisors, as well as word of mouth from past REU students. Student selection is based on a combination of factors, including GPA, letters of recommendation, enthusiasm expressed in the personal statement, prior research/hands-on experience, geographical location, type of home institution, as well as prior coursework. Our program announcement expressly states that no prior research experience is required and, indeed, most of the students selected to take part in the program had no prior research experience. We each year try to select a mix of students that provides a balance between students who have a lot of hands-on experience and students who have none. While most of the past participants had completed their sophomore or junior year in college prior to taking part in the program, we also try to include students who have just completed their freshman year.

Between 2006 and 2008, this NSF/DoD grant provided funding each year for eight students and is providing funding for 10 students per year between 2010 and 2012. Additional funding was sought and obtained from Oakland University's Office of the Provost and Vice President for Academic Affairs to support three additional OU students, bringing the total number of student participants to 37 students from 30 different institutions across the U.S. who took part in the AERIM program. Their GPA's varied between 2.98 and 3.96 and averaged about 3.5 each year. The students came from a variety of institutions, including 4-year colleges, colleges with limited graduate programs, institutions designated by the Carnegie Foundation as being research intensive and extensive universities, as well as a community college. Of these 37 students, only four had any prior research experience (as high school or college students) and only six had prior co-op or internship experience. Hence, in all four years, this was for most students their first exposure to research and engineering outside of a classroom setting.

Program Structure and Activities

The program runs for 10 weeks during the summer. Students received a $4,000 stipend in 2006-2008 and a $5,000 stipend in 2010, free on-campus housing, as well as a small meal allowance and membership to the campus recreational facilities. Travel expenses to OU were reimbursed and students were provided with a one year membership to SAE and SWE. We found that social and professional interactions and bonding between the students increased as a result of the shared dormitory accommodations and hence tried as much as possible to offer on-campus housing to

local students as well. Students worked in teams on their respective research projects. The teams worked closely with the faculty members supervising their projects, graduate students, and one or two industrial mentors. In addition, a number of group activities were also organized. These included seminars, ethics workshops, weekly lunch meetings with faculty and professionals from industry, lab or industrial facility tours, short courses, a conference and other activities. Students also gave midterm and final oral and poster presentations about their research projects. As an example, listed in Table 1 are some highlights of the schedule of group activities during one of the summers (Note that not all activities are listed in the table; in particular, activities/tours that were specific to individual project teams are not listed in this table).

Table 1 – Highlights of REU Group Activities by week number, sample summer

1	• **Welcome and Orientation**; Introduction of participating faculty and mentors; Introduction of participating students; Description of REU program, activities, expectations; Open discussion on research; Lunch with faculty and industry mentors; Paperwork; campus tour • Project Descriptions: Overview of each project; Lab tours; Library orientation and online resources • Project Selection: Open discussion with faculty on projects; Survey on project preference; Project assignment
2	• Introduction to using the machine shop and shop safety • Overview of Research; research careers; research methodologies; ethics, teamwork; research presentations • Introduction to Computational Fluid Dynamics • **Seminar**: "Advanced Power - New Technologies and New Business Models for the Future of Transportation," André Metzner, Hybrid Development Center and Thomas Max, Director and CFO of Bertrandt U.S., Inc • Thursday lunch with faculty and industry mentors
3	• SAE Young Automotive Professional **Conference**, Ford Dearborn Development Center • **Tour** of Chrysler Sterling Heights Assembly Plant • Thursday lunch with faculty and industry mentors
4	• Thursday lunch with faculty and industry mentors • Ethics workshop
5	• **Tour** of Chrysler Aero-acoustic Wind Tunnel facility and lunch • Student midterm research presentations • Thursday lunch with faculty and industry mentors
6	• **Seminar**: "Applications of Computational Fluid Dynamics in the Automotive Industry," Ken Singh, Aero & Fluid dynamics manager, Chrysler • Thursday lunch with faculty and industry mentors
7	• **Seminar:** "Introduction to automotive engines;" Dr. Alex Alkidas, Senior Staff Research Engineer (ret.), GM R&D • Thursday lunch with faculty and industry mentors
8	• Graduate School Information • Lunch meeting with Meg Novacek, Director, Powertrain Systems Engineering, Chrysler
9	• **Tour** of GM R&D Lab and lunch • **Seminar**: "Future of Combustion Research," Dr. D. Reuss, Senior Staff Research Engineer ,GM R&D • Thursday lunch with faculty and industry mentors
10	• Final Project Presentations • Farewell lunch

Some of the unique opportunities that were provided to the students included visits to the Chrysler Sterling Heights Assembly Plant (where the Sebring is manufactured and which is generally not accessible to public), the Chrysler Aero-acoustic Wind Tunnel facility, a GM Engine Research Lab and a DTE power plant; the Society of Automotive Engineering Young Automotive Professionals Conference and the Meeting of the Minds Undergraduate Research

Conference; and seminars on contemporary automotive topics by experts from the auto industry. Students also met with and were inspired by, among others, one of the highest placed women in the auto industry, Ms. Meg Novacek, Director of Powertrain Systems Engineering at Chrysler. One of the goals of such meetings is to inspire and motivate students and to broaden their thinking about potential career goals and interests.

Since Oakland University has been hosting other REU and summer programs on campus, when possible, efforts were made to organize joint events or activities with some of the other programs, as well as to house students in the same dormitory facilities to encourage camaraderie and the free-flow of ideas across disciplines. Not only have such joint events appealed to students, they also allow the faculty involved to combine their efforts and resources. Examples of such joint events include information sessions on graduate school, picnics, airport transportation, seminars, attendance at an SAE conference and in 2010 a joint poster session and farewell lunch. Care must however be taken not to overdo such joint events as one then risks losing some of the benefits of a small group setting.

While it is good to spread the various group activities out over the 10 week session, we suggest scheduling most of the tours and seminars earlier in the program if possible. We found that by the 7th or 8th week, students were really absorbed by their projects and getting close to deadlines, and would have generally preferred to have more time to work on their projects. As can be seen from Table 1 (week 9), this may not always be possible, particularly in the case of industrial lab or plant tours where one must accommodate the scheduling constraints of the industrial partners. We have tried over the years to schedule such tours as far in advance as possible, but have not always been able to do so; it is hence important to keep the schedule somewhat flexible to allow for last minute scheduling changes or impromptu additions.

If the budget allows for it, we highly recommend scheduling several coffee or lunchtime (pizza) meetings with professionals of varying backgrounds. These were always a great hit and don't require too much time on the part of all involved. Depending on the personalities of the individual students and industrial visitors, faculty may need to take an active role in getting a conversation started. One may for example begin immediately with introductions all around and ask each person to tell something personal about themselves (where they're from, hobbies or side interests, etc.) Once the introductions are complete, the faculty member may encourage the students to ask questions or ask questions that s/he thinks would be of interest to them to get the conversation going. Depending upon the 'chemistry', we have found that these discussions can be quite lively. If time allows, have each of the student groups take a few minutes to talk to the mentor about their research projects.

Student Projects

Eight faculty members have over the years volunteered to supervise student projects. Additional faculty members assisted with some of the group activities and assessment process. Given the time commitment required to supervise an REU student project, faculty advisors were provided with a small monetary compensation (the PI elected to only take a nominal compensation in order to ensure that this was possible) and were selected based on their proposed projects, availability during the summer and their dedication to students. Whenever possible, we tried to

assign two faculty advisors to each project; given that many faculty members need to travel to conferences or for other business during the summer, having more than one faculty member advise a given research project makes things easier for all involved and also makes it easier to recruit faculty members to assist with the program. The PI was always available to step in to assist with any project when necessary. If possible, we recommend offering faculty members a "year off" once in a while, as REU programs require a significant time commitment over the summer and there is always the potential for burn-out. It is also important to set clear expectations (e.g., are the advisors expected to attend weekly group meetings or field trips?). We have also found that the REU students really enjoy working on research projects with other graduate students, so graduate students often play an important mentorship role over the 10-week summer session. Potential REU project topics were usually solicited from faculty in December/January, and the actual projects were usually finalized a few weeks prior to the start of the program. All project topics were discussed in pre-program meetings with the faculty advisors and adjustments were made to ensure that they were doable and appropriate for undergraduate students.

Some initial information about potential research projects was provided on the program website and student applicants were asked to provide some information regarding their experimental/ laboratory /computing background in their online application. This assisted us in selecting the student participants in such a way to ensure a mix of skills, interests and backgrounds. We specifically included students who had virtually no "hands-on" experience and who would hence greatly benefit from this type of experience, but we each year also included a few students who were more familiar with automotive components or experimental techniques. In order to help students make an informed decision about their project selection, each faculty member gave an overview of his/her project on the second day of the program and gave students the opportunity to tour the lab facilities and ask questions before being asked to rank the projects by order of preference on the third day. The assignment of students to a specific project involved consideration of the students' preferences, as well as trying to pair up appropriate skills and backgrounds to each project. Most students received their first or second choice and were generally pleased with the project assignment process. We found that it was important to maintain some flexibility during this process and to be open to adjusting the focus of some of the projects based on the interests and background of the students. All of the students had the opportunity to use experimental techniques or equipment that most undergraduates would rarely have a chance to use, and interacted with faculty, graduate students, industry mentors and staff. Following our assessment of the program after the first year, we decided to provide training on the use of machine shop tools to all students at the beginning of the program. Although the students were very resourceful and were very good at seeking help from the machine shop staff or teaching each other how to use different tools or equipment when necessary, we felt that such training would help to level the field somewhat at the beginning of the program. This is especially critical to those students who come in with virtually no hands-on experience and who might feel a bit insecure at the beginning of the program. Many of the students were also introduced to numerical simulation tools, such as Comsol® and Fluent® for Computational Fluid Dynamics (CFD) simulations, and LabVIEW® software for data acquisition and control, as well as to advanced optical techniques such as shearography and Digital Image Correlation (DIC).

One of the key determinants of the success of any undergraduate research experience is the appropriateness of the research project for an undergraduate student, both from the standpoints of interest and ability.[6, 18] A good project should be doable, relevant, meaningful and engaging for the student. It should involve active inquiry or investigation that makes an original intellectual or creative contribution to a research problem. It should capitalize on the individual student's interests and strengths, allowing the student to develop a higher level of confidence in his/her abilities, while at the same time allowing him/her to explore different areas and develop new skills. The emphasis on do-ability should not however be construed as synonymous with straightforwardness or easiness. Students need to be encouraged to explore multiple paths towards the solution of a problem and to acquire a sense of ownership of the project. Experiences with failure, frustration and setbacks should be normalized as being an inherent part of research.[1] This is particularly true in the case of experimental work. We have also found that involving students in ongoing research projects is more effective for all involved. Students then have more opportunities to work side by side with graduate students and faculty and are more likely to complete their project by the end of the summer. Although there is great learning value to starting a new project from scratch, students will tend to be more satisfied at the end of the semester if they have concrete results to show.

All of the REU students were encouraged to present their research results at professional conferences after completing the REU program and were offered funding to do so; nearly half of the students have taken advantage of this opportunity so far; the rest could not, citing coursework conflicts as a reason. Hence a more concerted effort is currently underway to further encourage the students and faculty advisors to present their research findings in professional settings and at least eight of the eleven participants from the 2010 program intend to or have already done so.

Program Assessment

The REU program was assessed in a number of ways: online pre-REU and post-REU surveys were conducted to assess the expectations of the students, their opinions and beliefs about engineering, graduate school and research and their level of satisfaction with different aspects of the program; the PI then contacted every REU student by phone and e-mail at regular intervals of 3-6 months to determine the long term impact of the REU program on the students' professional and educational choices. Despite changes in many of the students' contact information over time, the PI has managed to track down and stay in touch with 34 of the 37 students as of January 2011. Table 2 summarizes the gender/ethnicity, affiliation, GPA and current status of each student who took part in the AERIM REU program between 2006 and 2008 (all of the 2010 students have not graduated yet, so only their basic information is included). A number of positive conclusions can be made based on the relatively long-term data that has been collected so far.

Student Diversity: The AERIM REU program was successful at recruiting and motivating talented female and underrepresented engineering students in proportions that exceed national averages: 19 out of the 37 REU students, i.e., about 51.4%, were female. Twelve out of the 37 students, i.e., 32.4% were either Hispanic, Asian American, African American or Arab American.

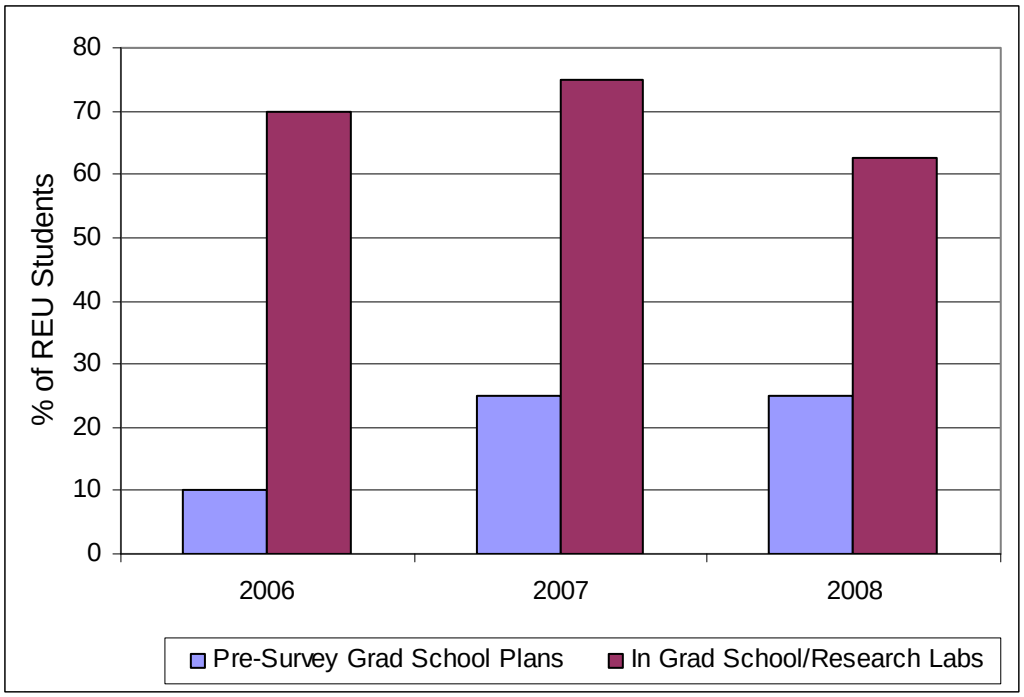

Figure 1 – Comparison of pre-REU survey results and actual post-graduation graduate school/research lab attainment (2006-2008)

Post-graduation: One of the stated goals of the AERIM REU program was to increase the number of students selecting to pursue graduate degrees in STEM fields or careers in scientific research. As illustrated in Figure 1, between 10% and 25% of the 2006-2008 students indicated plans to go to graduate school in the **pre-REU** surveys; the rest were either undecided or planned on working post-graduation. These percentages increased significantly in the post-REU survey (given on the last day of the program). More significant, however is the fact that of the 26 students who took part in the REU program between 2006 and 2008, 17 have enrolled in graduate engineering programs and 2 decided to work at NASA research centers (one student took part in the NASA USRP program the summer after the REU, then later decided to join the NASA Jet Propulsion Lab and is now also pursuing an M.S.A.E.; another was admitted to several graduate programs, but as an AE major, did not want to miss the opportunity of working at NASA Glenn Research Center). Hence, so far, 73.1% of the graduates have chosen to follow a graduate school and/or research path. Furthermore, of the remaining 8 students who have graduated but have not enrolled in a graduate program or worked in a research setting, 6 are either in the process of applying to M.S. programs or have done so in the past and elected to delay their graduate studies for financial reasons. That brings the percentage of graduates who have applied to or enrolled in graduate school or have elected research careers to 88.5**%**, which is a significant improvement over the pre-REU survey results. While we obviously cannot attribute all of these outcomes solely to the AERIM REU program, we know based on emails and conversations that we have had with many of the students after they left the program, that their REU experience and the interactions that they had with faculty and industry researchers played a significant role in their decision-making. For example, a student stated in an email to the PI "*I've settled in at Georgia Tech and have already started working on research. I'm working with Professors … and … studying phonon transport at material interfaces by optical*

methods… The REU program and all of your help and advice was a huge part of me getting here. Thank you so much for everything." Another stated that "*I think that the REU program had the biggest impact on my decision to get my masters but also furthered deepened my desire to work within the automotive industry… Working side by side with mentors from the industry was a great experience to further motivate me towards my future goals."*

Satisfaction: On a scale of 1 to 5, with 1 being poor and 5 being excellent, students rated their overall REU experience as a 4.7 and all indicated that they would recommend the program to their friends. Most of the activities received ratings above a 4.0 and the ratings for categories involving *improvement in skills* (e.g., hands-on and communication skills) and *self-confidence* all had average ratings of 4.4 or higher. Follow-up contact with the students indicates that most felt more confident in their abilities as a result of the REU.

Based on these ratings and comments received from the students, we consider this program to have been a success in all four years. We are particularly pleased with the fact that we have been able to stay in touch with most of the students so far and that most of them are heeding the graduate school message. We will continue to monitor their progress and to look for ways to improve the program and its outcomes.

It is important to note that one of the greatest difficulties in medium to long term assessment of REU programs is the difficulty of staying in touch with students after they leave the program. We have found some of the following approaches to be helpful: regular e-mail contact by the PI; occasional phone calls; Facebook pages and LinkedIn profiles.

Table 2 – Summary of affiliation, gender, race. GPA and current status of ARIM REU students (2006-2008)

	Affiliation	Gender/ Race [1]	GPA	Current Status/Plans GREEN = In grad. School/Gov. Research Lab; BLUE = Applying/applied to graduate school
2006	Univ. Colorado Boulder	F, CA	3.8	Working at **NASA Glenn Research Center**; applied to grad programs in 2008, but chose to join NASA instead
	Princeton University	F, CA	3.3	Working at **NASA Jet Propulsion Lab**; completed USRP at NASA Langley in 2007; pursuing M.S.A.E. degree at USC
	GA Inst. of Technology	M, AP	3.96	Pursuing **Ph.D. in Biomedical Engineering** at Univ. Southern California
	University of Oklahoma	M, CA	3.7	Works for Flight Safety International Simulation Systems; applied to grad programs and is interested in pursuing PhD
	Oakland University	M, AA	3.1	Worked for Magnesium Products of America, an auto component manufacturer; now pursuing M.S. at OU
	University of Idaho	F, CA	3.38	Pursuing **M.S.M.E.** at the University of Idaho
	Univ. of New Hampshire	F, CA	3.43	Working as reliability manager for Anheuser Bush; applying to grad school this fall
	Rochester Inst.Technology	F, CA	3.16	Completed **M.S.M.E** from RIT and now working for Michelin
	Oakland University [2]	M, CA	3.62	Worked for Cessna Aircraft; started pursuing **M.S.M.E.** at Wichita State Univ. and now working at GM
	Oakland University [2]	M, CA	3.77	Working in the auto industry; considering grad school later
2007	Youngstown State Univ.	F, CA	3.5	Working for Babcock and Wilcox; pursuing **M.S.M.E** at Univ. Akron
	Grinnell College	F, CA	3.25	Working in **Greece** as a web developer; completed internship at NREL in 2008; Applying to Computer Science M.S. programs this Fall
	University of Arizona	F, CA	3.93	Pursuing **M.S.M.E.** at Univ. of Arizona; Applying to other schools for **PhD**; applying for NSF graduate fellowship
	Univ. of Missouri-Columbia	F, CA	3.6	Working at Burns & McDonnell; plans on getting MBA later
	University of Michigan	M, CA	3.5	Pursuing **Ph.D. in M.E.** at Georgia Tech
	Embry-Riddle Aeronautical Univ.	F, LA	3.44	Completed **M.S.A.E.** at Embry-Riddle Aeronautical Univ.
	North Carolina State Univ.	M, AP.	3.86	Completed **M.S.M.E.** at Univ. of Wisconsin-Madison. Pursuing **Ph.D. in M.E.** at Georgia Tech
	Oakland University	M, AR	3.46	Completed **M.S.M.E.** at Oakland Univ. with REU adviser; Pursuing **Ph.D. in M.E.** at Georgia Tech
2008	Lake Superior State Univ.	M, CA	3.96	Pursuing **M.S.A.E.** at Old Dominion Univ.
	Baylor University	M, CA	3.53	Graduated Fall '09; As of last communication was applying to graduate M.S. programs; was intern at L-3 Communications
	Florida International Univ.	F, LA	3.44	Pursuing M.S.A.E. at Univ. of Florida; Upcoming summer internship with Boeing
	Valparaiso University	F, CA	3.77	Graduated May '10; completed **Summer research** at Technische Universtät Darmstadt in **Germany** in 2009; applied for Fullbright scholarship in 2010; Plans to get Ph.D.; currently working in South Korea
	Youngstown State Univ.	F, CA	3.52	Graduated Dec. '10; applying to graduate M.S. programs; intern at GE

	University of Michigan	M, CA	3.4	Pursuing M.S.M.E. at Univ. of Michigan
	Franklin W. Olin College of Engineering	F, AP	3.63	Graduated in May '09; Consultant at Quorum Business Solutions
	Univ. of Rhode Island	M, CA	3.3	Working at the Naval Undersea Warfare Center; pursuing **M.S.M.E.** at Univ. of Rhode Island
2010	Macomb Community College	F, AP	3.93	Now enrolled in Chemical Eng. Program at Univ. of Michigan
	George Washington University	F, CA	3.70	Majoring in civil engineering; currently doing study abroad in Ireland; applying to REU programs; SAE conference paper
	Johns Hopkins Univ	M, LA	3.92	Applying to NASA Applied Physics Lab Internship Project and REU's
	Texas Christian Univ.	M, LA	3.92	Secured summer internship; SAE conference paper
	Ohio Northern Univ.	M, CA	3.86	Graduating in May 2011; applied to graduate programs at Purdue and Ohio State; SAE conference paper
	Univ. of Denver	F, CA	3.75	Planning on applying for summer research programs
	Loyola Marymount University	F, CA	3.65	Graduating in May 2011; Working on nano-research project at her school; applied to various graduate programs.
	Oakland Univ.[2]	F, CA	3.64	Applying for summer internships; SAE conference paper
	Rowan University	M, CA	3.58	SAE conference paper
	Oakland Univ.	M, AA	3.53	Graduating in Fall 2011; Applying for summer internships
	California Poly. State Univ, San Luis Obispo	M, LA	2.98	Planning on a full year study abroad next year in Germany; applying for internships; would like to return for REU

[1] CA = Caucasian; AA = African American; AP = Asian, Pacific Islander; LA = Latino, Hispanic; AR = Arab American

[2] Supported by funding from Oakland University's Office of the Provost and Vice President for Academic Affairs

Conclusions

Setting up and running an REU program is a very time consuming project. It requires a group of dedicated faculty who are willing to work hard over the summer, for little pay, with the ultimate goal of providing a meaningful, exciting and inspiring learning experience for the undergraduate students. The pay-off at the end comes from watching students grow intellectually in a matter of 10 weeks, gain confidence and develop a new-found enthusiasm for the field of engineering. Although there are always things that one can do to improve the program, all of the people involved in the program feel that this has been a successful program so far and look forward to next summer. Comments such as the ones listed below (edited for minor typos) make it all worth it.

> *"Overall this was a great program. I feel that I learned a lot and that I now have more experience under me. I feel like this program was guided enough that I didn't feel too lost, but I was able to explore the research process. I have many positive experiences and memories that I will be sure to share with other students. You were all very supportive and caring. Thank you!"*

> *"I loved this program and would recommend it to anyone. I learned a lot and I really feel that I accomplished something at the end of the summer even though I had my doubts all along. This program has really got me thinking about what I want to do with my future*

and it has made the thought of going to graduate school less scary. If I can get in, I'm going."

"This summer was one of the best experiences I've ever had. Thank you for selecting me."

"I think that the REU program had the biggest impact on my decision to get my masters but also furthered deepened my desire to work within the automotive industry. Not only did I get to immerse myself in a project that introduced me to research skills and procedures, I also got to see many other kinds of jobs within the automotive industry that made me look forward to the future. I learned a lot about the different types of jobs that an engineer can do from running tests and analyzing data in a wind tunnel to managing groups on a project or conducting a small part of a large research project. Working side by side with mentors from the industry was a great experience to further motivate me towards my future goals."

"My fall semester was the busiest I have been, but it went well and I enjoyed it. I was also able to talk to one of my professors and started to conduct research on campus with him. The REU program was definitely the reason for that decision, since I enjoyed the program and thought I would like further research. I have now finished most of my graduate school applications and look forward to hearing back from the schools. I hope everything is going well with you. I also hope you continue the REU program, since I found it to be very helpful, especially with my decision to pursue a graduate degree."

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